



Federal Panel on Agency Needs for Program Evaluation

2011 Winter ESIP Fed. Meeting

*Lawrence Friedl
Applied Sciences Program
NASA Earth Science Division*

5-January-2011

*Discovering and Demonstrating Innovative and
Practical Applications of Earth Science*



Applied Sciences Program

Program Strategy & Goals

Goal 1: Enhance Applications Research

Advance the use of NASA Earth science in policy making, resource management and planning, and disaster response.

Goal 2: Increase Collaboration

Establish a flexible program structure to meet diverse partner needs and applications objectives.

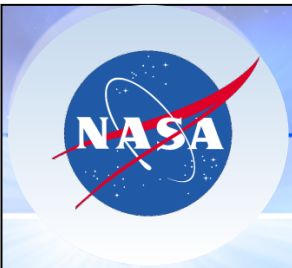
Goal 3: Accelerate Applications

Ensure that NASA's flight missions plan for and support applications goals in conjunction with their science goals, starting with mission planning and extending through the mission life cycle.

Outcomes are manifest in organizations' enhanced policy and management decisions.

Impacts are the resulting socioeconomic benefits from the improved decisions.

<http://AppliedSciences.NASA.gov>

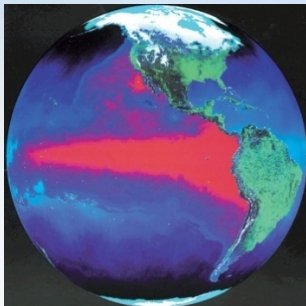


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USGEO Societal Benefit Areas



Agriculture



Climate



Disasters



Ecosystems



Energy



**Health
(incl. Air Quality)**



Oceans



**Water
Resources**



Weather



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Performance, Evaluation, and Impacts

- Substantive projects and successes in applications;
Yet inability to substantiate the socioeconomic benefits & impacts
- Strategically important for Earth science community to have skills & abilities (or know how to access them) to document impacts
 - Need across regions, sectors, topics, data types, etc.
- Part of effort is bridging the social sciences & economic fields with the Earth science and physical science fields.



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Performance, Evaluation, and Impacts

Familiarity with Terms

Economics & Policy Analysts

- Shadow Price
- Discount Rate
- Marginal Utility
- Cobb Douglas Function
- Revealed Preference
- Bayesian Inference
- Price Elasticity
- Pre-Post Analysis

Remote Sensing & Earth Science

- Orthorectification
- Synthetic Aperture
- Nearest Neighbor
- Kriging
- Supervised Classification
- Passive Microwave
- OPeNDAP
- Spectroradiometer

Terms shared by both (though meanings may differ)

- | | |
|---------------------------------|----------------------------|
| - Lagrangian function | - Sensitivity Analysis |
| - Probability density functions | - Monte Carlo |
| - Markov Processes | - Regression and R-squared |



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Performance, Evaluation, and Impacts

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We shouldn't expect either field to become expert in the other. We do need to find ways to make connections. Desire is that Earth science people will know people to contact in other fields to do an evaluation and an analysis of socioeconomic benefits.



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Assessment of Need & Opportunity

- Need in Earth science community for guidance and examples of the analytic techniques and methodologies
- Need for development of case studies and body of literature across different sectors, types of decision making, and applications topics
For example, techniques to articulate benefits of Earth science for improved volcanic ash advisories is likely different than for reservoir management or fisheries.
 - Depending on the decision making, the technique and measure may need to address efficiency, productivity, cost, effectiveness, or other metric.
- Also need for good 'stories' and human interest anecdotes
 - Relate the data products to individuals (direct or indirect)



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Activities on Performance and Impacts



ESD Applied Sciences Program *Value of Information and Socioeconomic Benefits Workshop*

Summary

Workshop to Examine Analytic Methods for Determining the Value of Information

- Supports efforts in Earth observations community to quantify societal benefits from use and application of Earth obs. data in decision making

Commissioned by ESD Applied Sciences
Organized and Hosted by:

Dr. Molly Macauley
Resources for the Future (RFF)

10 invited papers and discussants

Publication planned for single volume on developments in value of information research and applications

June 28-29 at RFF in Washington, DC

Topics & Organizations

- Earth Obs in Environmental Regulation: The Case of Land Use and Pollution (USGS)
- Malaria Diagnostics (Harvard)
- Land Cover & Climate Change Mitigation (International Institute of Applied Systems Analysis)
- Earth Obs. and Rift Valley Fever Vectors (Georgetown Univ.)
- Information and Catastrophe (RFF)
- Public Health Information (Wharton/U.Penn)
- Consumer Choice and Advertising (UMd)
- Earth Observations and Weather Index Insurance (Columbia)





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Socioeconomic Benefit Analysis

**Program initiated an effort to calculate the societal benefit of the use of NASA Earth science products for decision support.
Initial analysis focused on two projects:**

Malaria Early Warning Project: The Malaria Early Warning System (MEWS) amalgamates information from a wide variety of sources to support malaria prevention – ***the project integrated NASA remote sensing data into MEWS for Africa to improve malaria prevention and reduce morbidity and mortality***

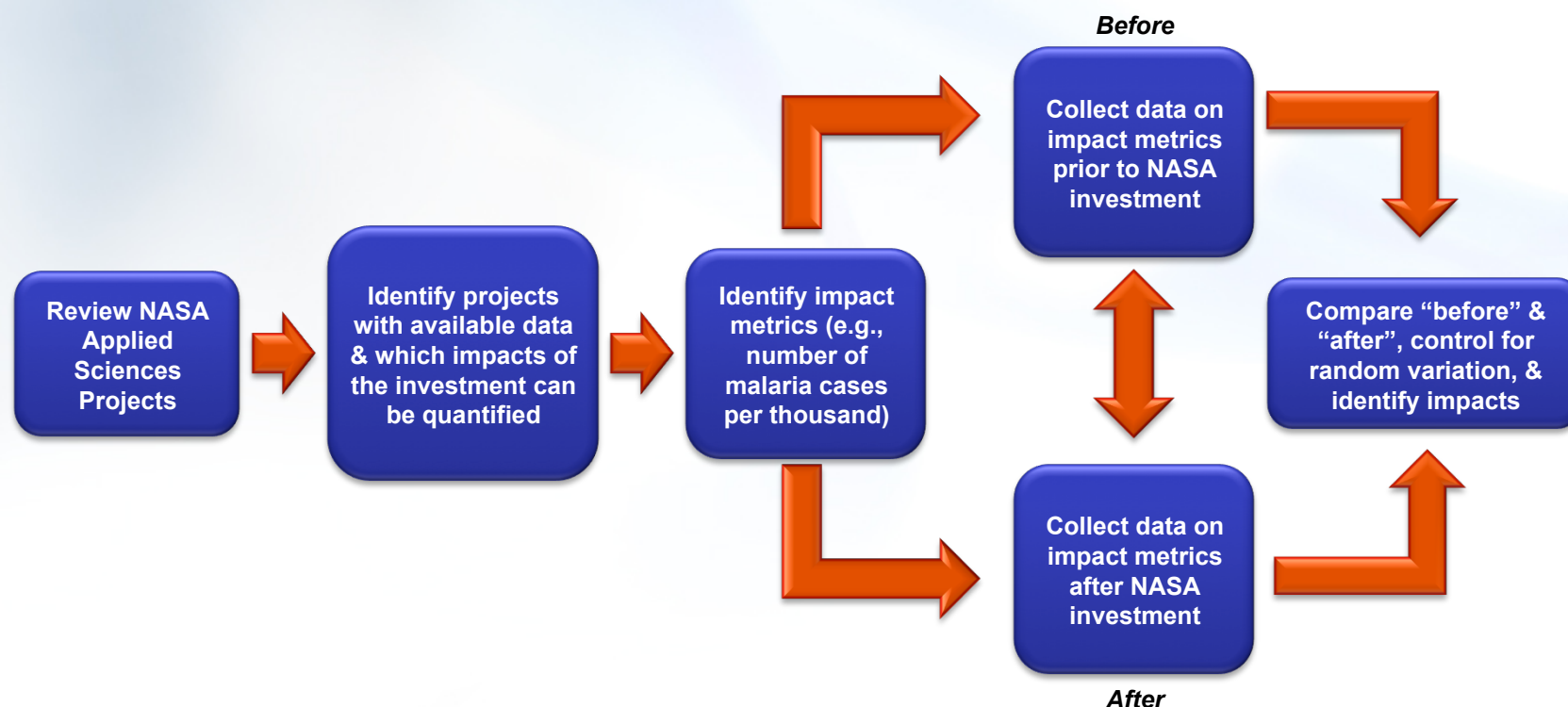
BlueSky Project: BlueSky is a model framework developed by the U.S. Forest Service to predict the smoke effects from wildfires, prescribed burns, and agricultural burns – ***the project integrated NASA remote sensing data into program to improve burning decisions and issuance of smoke-related health warnings***



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Overall Approach

The project adapted expected value of information (VOI) methodology to assess the benefits of each project – that is, the value of information is a function of the benefits that result from a decision with information compared to the decision that would have been made without the information. For this project we compared program outcomes prior to the availability of NASA provided information and after NASA information was available.



Using this approach, the value of information provided by each project would be:

Value of NASA Provided Information = Outcome with information – Outcome without information



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MEWS Analysis Results

Based on the analysis, as a result of integrating NASA Earth observations data/information into MEWS:



Additional Improvement in Reduction of Cases of Malaria: On the average, the number of cases of malaria reported in Botswana decreased approximately 21 percent per year before completion of the NASA data project. In the first year NASA data was used, the number of cases decreased by 27 percent



Reduced Cases of Malaria and Malaria Deaths: Around 420 cases of malaria and around 1 death were likely avoided in Botswana in 2008 as a result of the project



Potential Africa-Wide Benefits: If the other 28 Sub-Saharan countries used MEWS (with NASA data) as Botswana does, approximately 1 million cases per year could be avoided



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BlueSky Benefit Analysis Results

**Based on the analysis, as a result of integrating
NASA Earth observation data/information into BlueSky:**



Improved Wildfire Prevention: The average annual number of prescribed burns (which reduce the probability of wildfires) in California increased by approximately 4 percent



Improved Smoke Forecasts: The average annual number of BlueSky spot forecasts issued within USFS Region 5 increased by 14 percent between the pre- and post-implementation periods



Reduced Hospitalization from Smoke Exposure: A comparison of pulmonary hospitalization events during two major California wildfires yielded approximately 140-150 avoided hospitalizations and \$915,000 in avoided hospitalization costs.



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Applications Readiness Levels (ARL)



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TRL Equivalent for Applications

Technology Readiness Levels (TRL)

Provide systematic means to assess and communicate the evolving level of maturity of a particular technology (or application project)

Allow consistent comparisons of relative maturity among projects

Articulate the continuum on which an technology or application should progress

Program and project managers use TRL for assessing the level of effort and costs to conduct specific activities and meet milestones.

Gauge projects' current state, progress, and trending to guide where programmatic interventions might be best targeted.

TRLs used extensively by NASA ESTO and Flight Programs



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Applications Readiness Levels

Applications Readiness Levels (ARL)

9. Approved, Operational Deployment and Use in Decision Making
8. Application Completed and Qualified
7. Application Prototype in Partners' Decision Making
6. Demonstrate in Relevant Environment
5. Validation in Relevant Environment
4. Initial Integration and Verification
3. Proof of Application Concept
2. Application Concept
1. Basic Research

*Partner
Demonstration
and Transition*

*Development,
Test, and
Validation*

*Discovery and
Feasibility*

ARL 9

—

ARL 8

—

ARL 7

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ARL 6

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ARL 5

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ARL 4

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ARL 3

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ARL 2

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ARL 1



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Applications Readiness Levels

Applications Readiness Levels (ARL)

Adapted TRL (Technology Readiness Level) for use in applications of Earth science to decision making activities.

- Assess maturity of Earth science applications projects
- Track integration of Earth science into decision making

ARL articulates expected advancement along a continuum.

- Partner's operational activity is applications' analog to space

How Applied Sciences will Use ARL in Evaluation

1. Support Program/Project communications regarding expected vs. actual levels of application maturation
2. Compare progress across projects and across Applications Areas
3. Conduct program-wide analyses to identify key or difficult stages in application development process requiring additional attention and to identify factors to increase probability of success.



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Science of Science Policy

The science of science policy (SoSP) is an emerging field of interdisciplinary research, the goal of which is to provide a scientifically rigorous, quantitative basis from which policy makers and researchers can assess the impacts of the Nation's scientific and engineering enterprise, improve their understanding of its dynamics, and assess the likely outcomes.

Recent workshop in early December 2010.

<http://scienceofsciencepolicy.net/>

<http://www.nsf.gov/sbe/sosp/>



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Back-up Charts

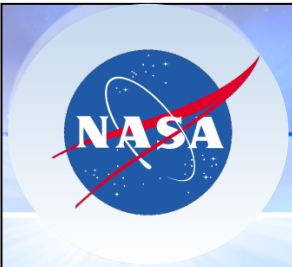


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TRL-Applications

TRL for Applications (TRL-A)

1. Basic Research
2. Application Concept
3. Proof of Application Concept.
4. Initial Integration and Verification (in Laboratory Environment)
5. Validation in Relevant Environment
6. Demonstrate in Relevant Environment.
7. Application Prototype in Partners' Decision Making
8. Application Completed and Qualified.
9. Approved, Operational Deployment and Use in Decision Making.



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TRL-Applications

TRL-A Levels 7-9

Goal: Complete the integration and transition of use of Earth science products for sustained use.

*Partner
Demonstration
and Transition*

TRL-A Levels 4-6

Goal: Develop and prototype capability of Earth science product to enhance decision making.

*Development, Test,
and Validation*

TRL-A Levels 1-3

Goal: Establish the information content, characterize decision support need, and assess proof of concept of application idea

*Discovery and
Feasibility*

TRL 9

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TRL 8

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TRL 7

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TRL 6

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TRL 5

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TRL 4

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TRL 3

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TRL 2

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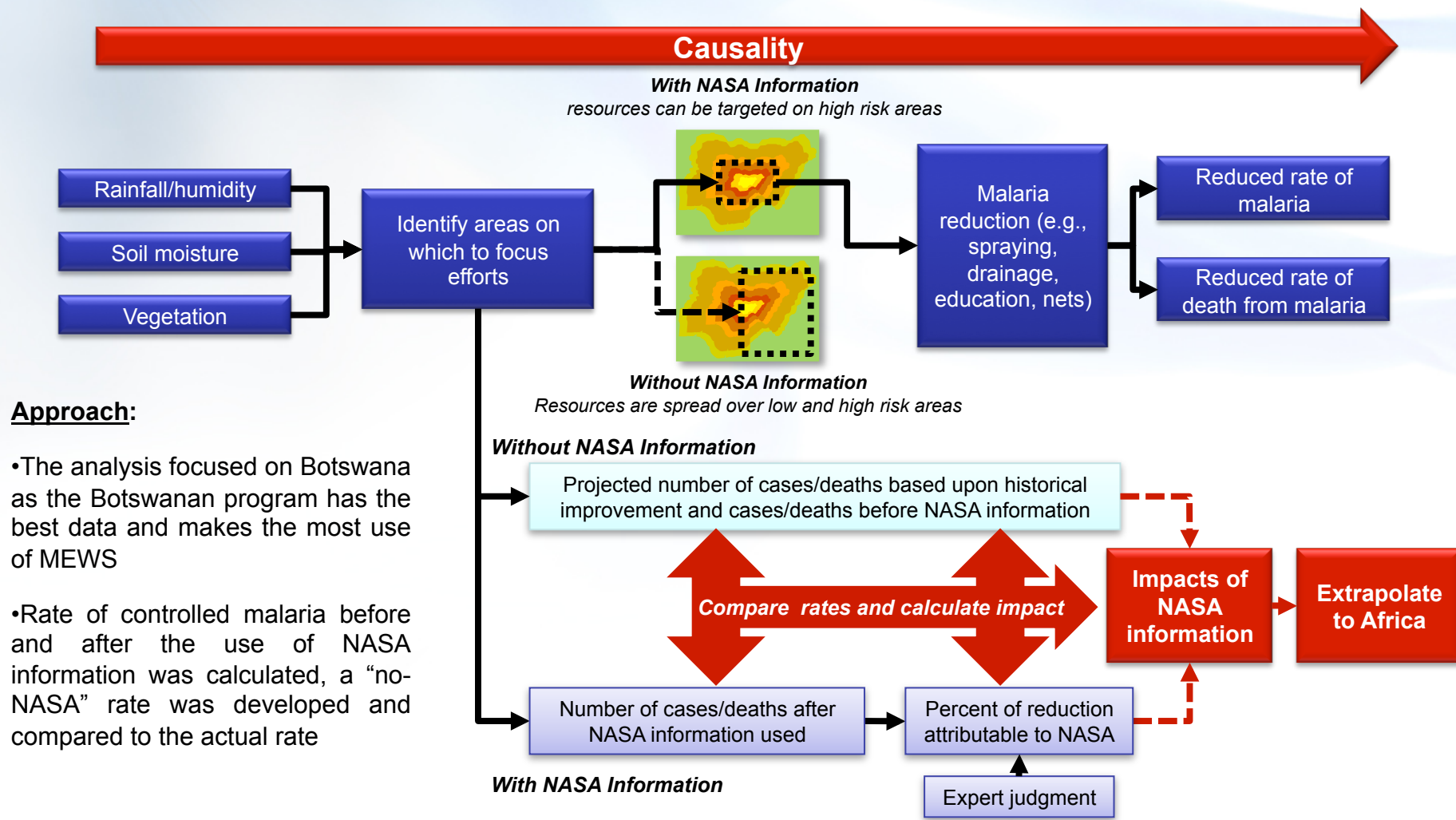
TRL 1



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MEWS Analysis Approach

Using NASA remote sensing with the MEWS Program helps national malaria programs better target malaria prevention activities which leads to reduced malaria cases and reduced deaths from malaria

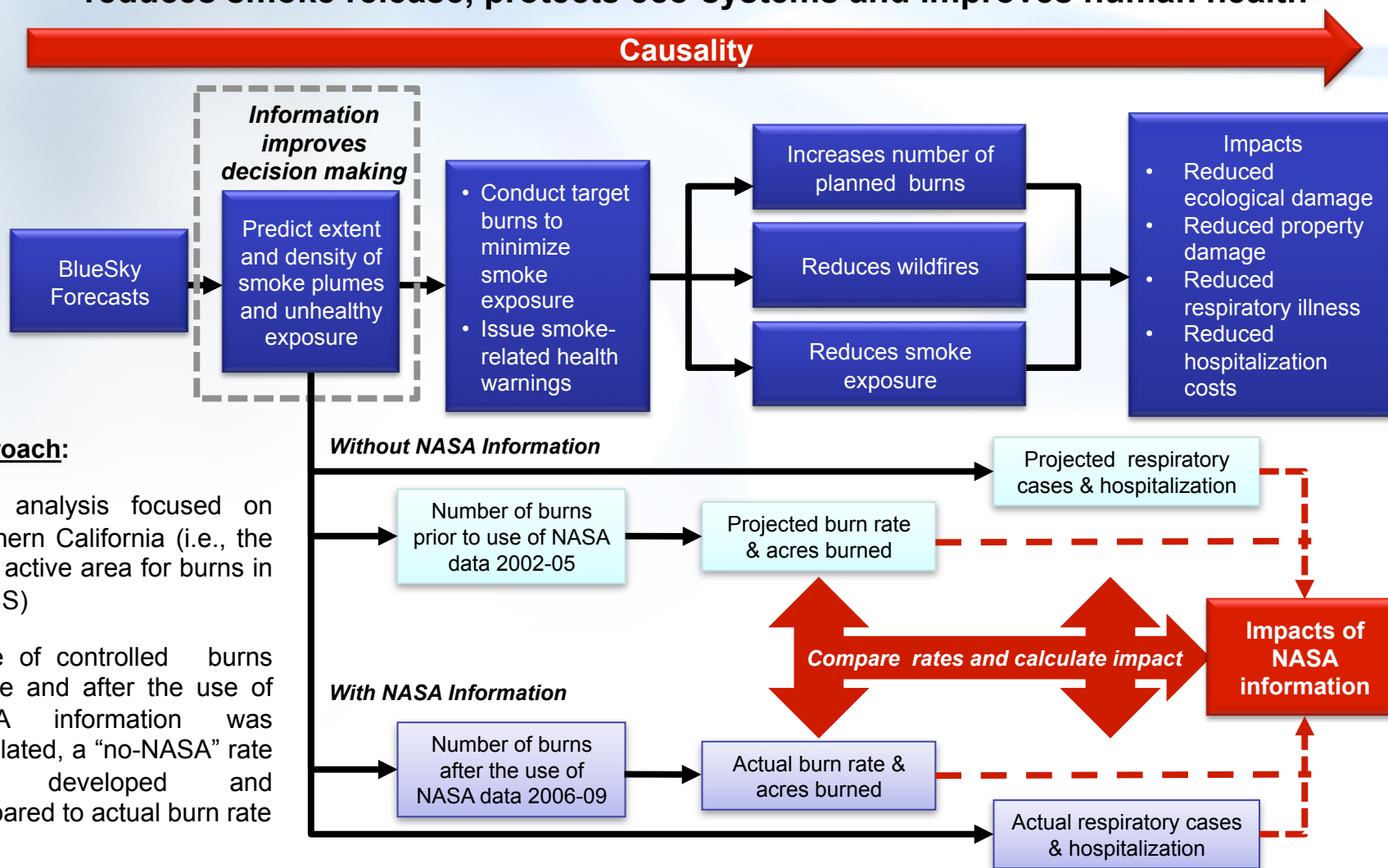




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BlueSky Benefit Analysis Approach

Using NASA remote sensing with the BlueSky Program reduced wildfires, reduces smoke release, protects eco-systems and improves human health





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Lessons Learned for Future Analyses

As part of this analysis we identified a number of lessons learned that may be useful for future analyses of the impacts of NASA investments



Identify Anticipated Impacts in Initial Project Documentation: There was considerable difficulty in identifying and defining anticipated or expected impacts of NASA investments. This would be considerably easier if projects identified anticipated outcomes or potential impact variables as part of project initiation.



Involve Project Staff and Stakeholders: Project staff and stakeholders were an important resource in identifying where projects made its biggest impact and where data could be found. Future impact analyses should involve stakeholders and project staff early and often to identify and validate impacts and potential data sources.



Comparative Analysis: A modified value of information/comparative analysis approach was shown to be the most effective in these cases. This analysis compared “before” and “after” states and analyzed impacts to determine the impact of NASA information.



Carefully Document Use of NASA Information: It proved to be difficult to determine when and how NASA information was used. Future analysis should be careful to document how and when information was used.



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Impact Analyses

Program Evaluation

OMB Direction and Proposal Solicitation for Program Evaluation Activities in FY11+ Budgets



EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF MANAGEMENT AND BUDGET
WASHINGTON, D.C. 20503

October 7, 2009

M-10-01

MEMORANDUM FOR THE HEADS OF EXECUTIVE DEPARTMENTS AND AGENCIES

FROM: Peter R. Orszag
Director

SUBJECT: Increased Emphasis on Program Evaluations

Rigorous, independent program evaluations can be a key resource in determining whether government programs are achieving their intended outcomes as well as possible and at the lowest possible cost. Evaluations can help policymakers and agency managers strengthen the design and operation of programs. Ultimately, evaluations can help the Administration determine how to spend taxpayer dollars effectively and efficiently -- investing more in what works and less in what does not.

Although the Federal government has long invested in evaluations, many important programs have never been formally evaluated -- and the evaluations that have been done have not sufficiently shaped Federal budget priorities or agency management practices. Many agencies lack an office of evaluation with the stature and staffing to support an ambitious, strategic, and relevant research agenda. As a consequence, some programs have persisted year after year without adequate evidence that they work. In some cases, evaluation dollars have flowed into studies of insufficient rigor or policy significance. And Federal programs have rarely evaluated multiple approaches to the same problem with the goal of identifying which ones are most effective.

To address these issues and strengthen program evaluation, OMB will launch the following government-wide efforts as part of the Fiscal Year 2011 Budget process:

- **On-line information about existing evaluations.** OMB will work with agencies to make information readily available online about all Federal evaluations focused on program impacts that are planned or already underway.
- **Inter-agency working group.** Together with the Domestic Policy Council, National Economic Council and the Council of Economic Advisors, OMB will establish a new inter-agency working group to promote stronger evaluation across the Federal government.
- **New, voluntary evaluation initiative.** As part of the Fiscal Year 2011 Budget process, OMB will allocate a limited amount of funding for agencies which, on a voluntary basis: